USAWC STRATEGY RESEARCH PROJECT

STRATEGIC IMPLICATIONS OF IMAGERY INTELLIGENCE

by

Ms. Cheryl D. McAuley
Department of Defense Civilian
National Geospatial-Intelligence Agency (NGA)

Doctor Tami D. Biddle
Project Advisor

This SRP is submitted in partial fulfillment of the requirements of the Master of Strategic Studies Degree. The U.S. Army War College is accredited by the Commission on Higher Education of the Middle States Association of Colleges and Schools, 3624 Market Street, Philadelphia, PA 19104, (215) 662-5606. The Commission on Higher Education is an institutional accrediting agency recognized by the U.S. Secretary of Education and the Council for Higher Education Accreditation.

U.S. Army War College
CARLISLE BARRACKS, PENNSYLVANIA 17013

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
18 MAR 2005		**-**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Strategic Implications of Imagery Intelligence	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
Cheryl McAuley	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)	8. PERFORMING ORGANIZATION REPORT NUMBER
U.S. Army War College,Carlisle Barracks,Carlisle,PA,17013-5050	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT
See attached.

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**		**47**	

ABSTRACT

AUTHOR: Ms. Cheryl D. McAuley

TITLE: Strategic Implications of Imagery Intelligence

FORMAT: Strategy Research Project

DATE: 14 March 2005 PAGES: 45 CLASSIFICATION: Unclassified

Imagery intelligence (IMINT) has been integral to decision-makers world wide. This paper explores lessons learned from World War II photo interpreters and their applicability to the United States' IMINT program of the 21st Century. The essay opens with a brief comparison of early French, German, British and American Photo Reconnaissance (PR) programs and then moves to an examination of PR in the Second World War. Human capital and coalition partnerships are key themes. In addition, two examples illustrate how the U.S. imagery tradecraft has influenced national security policies since the Cold War. Finally, I offer two recommendations for improving strategic IMINT operations of the present and future, now called geospatial-intelligence (GEOINT).

TABLE OF CONTENTS

ACKNOWLEDGEMENTS

I would like to thank several colleagues and individuals for their enthusiasm for this project. First, two of my colleagues in the USAWC Class of 2005, LTC Mohamed Robleh of Djibouti and COL Gerd Brandstetter of Germany for their translations of French and German references respectively; Dr. H. George Carls of Estenfeld, Germany, was a wealth of information regarding World War II German photo interpretation when I happened to meet him at the National Archives while we were both conducting research (He emailed congratulations after reading the paper and concurred with my statements about the German program.); Mr. Gerald Luchansky, an employee at the National Archives Records Administration (NARA) College Park, who made available to me original German documentation of World War II imagery interpretation equipment as well as pre-strike photos of the United Kingdom for my research; Mr. Chris Hughes, Joint Aerial Reconnaissance Intelligence Centre (JARIC) Historian, United Kingdom, who generously provided me JARIC's 60th Anniversary material; Mr. Gary Kernaghan, JARIC's Senior Intelligence Officer, United Kingdom, who upon reviewing the draft, eagerly emailed and phoned me concurrence to my conclusions and further facilitated my contact with JARIC's Historian; Mr. Shawn Dilles, my mentor from the National Geospatial-Intelligence Agency, for his leadership and generosity of sharing his personal library of history books, articles and knowledge about photo reconnaissance; Mr. Benjamin Crew also from the National Geospatial-Intelligence Agency, for his enthusiasm and professional knowledge of this difficult tradecraft; Dr. Tami Biddle, my USAWC SRP faculty advisor for taking on this project; Messrs. Shawn Mosholder and John Murray of USAG/DOIM were indispensable in formatting this paper; Ms. Jacqueline Bey of the USAWC Library for her patience and expertise with unusual Endnote and Bibliography entries; Chaplain (COL) Richard Pace for his spiritual leadership and optimism during this academic year; Finally but not least of all, my husband, CW5 John McAuley, who has provided the most important support of all in both my DoD Civilian and Army Reserve careers. He continues to be the "wind beneath my wings," making my life enjoyable and I am most grateful to him.

LIST OF ILLUSTRATIONS

LIST OF TABLES

STRATEGIC IMPLICATIONS OF IMAGERY INTELLIGENCE

> The military organization which has the most efficient reconnaissance unit will win the next war.
>
> - General Werner Freiherr von Fritsch, 1938[1]

Imagery intelligence (IMINT) has been integral to decision-makers world wide. This paper explores lessons learned from World War II photo interpreters and their applicability to the United States' IMINT program of the 21st Century. The essay opens with a brief comparison of early French, German, British and American Photo Reconnaissance (PR) programs and then moves to an examination of PR in the Second World War. Human capital and coalition partnerships are key themes. In addition, two examples illustrate how the U.S. imagery tradecraft has influenced national security policies since the Cold War. Finally, I offer two recommendations for improving strategic IMINT operations of the present and future, now called geospatial-intelligence (GEOINT).

DEVELOPMENTS PRIOR TO WORLD WAR ONE

From balloons to light aircraft, reconnaissance had major strategic implications for two hundred fifty years. This table outlines examples used by Europeans and Americans through the first World War. The French dominated the art through the mid-eighteenth century.

When	Where	Who	What	How
1670	Italy	Francesco Lana	Published Theory on bombing enemy from the air	Aerial Ship
1783	France	Montgolfier brothers	Theory of bombing city of Toulon during French Revolutionary Wars[2]	Hot Air Balloon
1789	France	French Army	Artillery spotting and reconnaissance[3]	Hydrogen-filled Balloons
1794	France	COL Coutelle	French Balloon Company during French Revolutionary Wars	Balloons
1856	France	Felix Tournachon	Camera tied to basket near Paris[4]	Balloon
1860	United States	J. W. Black	First successful photograph of Boston[5]	Balloon
1861	United States	J. Wise, J. La Mountain, Dr. Thaddeus Lowe	First observation during U.S. Civil War[6]	Balloon
1870	France	French	French communicated messages to the Prussians.[7]	Manned Balloons
1878	England	British	Established a balloon unit	Balloons

1882	England	British	School of Military Engineering	Balloons
1885	Sudan	British	Artillery correction[8]	Balloons
1898	United States	American	Aerial Reconnaissance during Spanish-American War[9]	Balloons
1899	England	British	Boer Wars[10]	Balloons
1909	France	M. Meurisse	Experimented w/still photography From aircraft	Aircraft
1911	England	British	Royal Engineers - Air Battalion[11]	Aircraft
1914	England	British	Battle of Mons	Aircraft
1915	England	Sidney Cotton (Australian)	Developed reconnaissance techniques[12]	Aircraft
1915	France	French	Supported artilleryman with 10,000 reconnaissance missions[13]	Aircraft
1915	Germany	German Air Service (Luftstreitkrafte)	Aerial reconnaissance provided early warning of enemy positions and assembly points, enemy rail yard activities, and preparations for river crossings (both enemy and friendly	Balloons (diameter of 10-20 meters), airships (Zeppelins and blimps)

TABLE 1 (TIMELINE OF STRATEGIC IMAGERY 1670-1915)

U.S. balloon reconnaissance was used by both the Union and Confederacy 1861-1862. (See Figure 1).

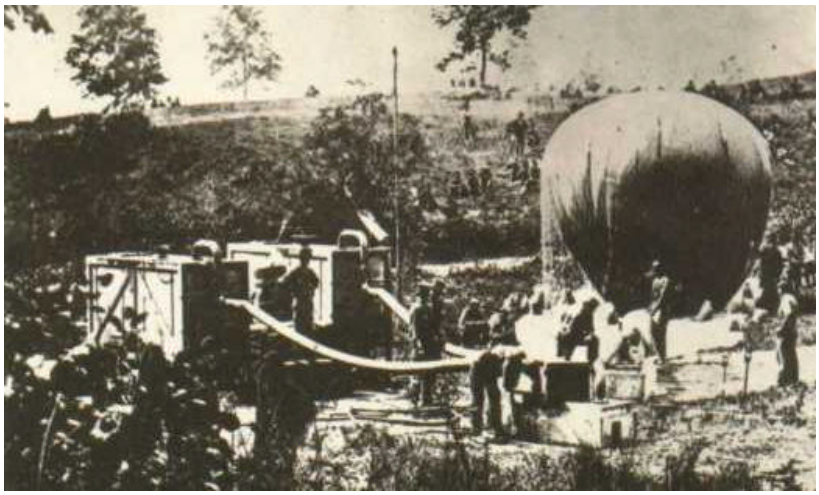

FIGURE 1 (LOWE'S BALLOON DURING THE U.S. CIVIL WAR JUNE 1862)[14]

DEVELOPMENTS IN THE FIRST WORLD WAR

World War I saw developments in aerial photography, the forerunner of IMINT and GEOINT.

FRENCH PHOTO RECONNAISSANCE (PR)

An example of imagery not used occurred in 1915. Observation of key sites in Germany revealed a facility which manufactured explosives and poison gas, but bombing efforts were curtailed due to the heavy loss of French bombers destroyed by German fighter planes.[15]

GERMAN PR

The Luftwaffe flew patrols of at least three aircraft to acquire aerial photography. Army commanders relied on photograph maps for situational awareness. They monitored forward area enemy trench lines, ammunition depots, villages, airfields, railroads, ports and camps, comparing newer and older photos for imminent enemy intentions. Wide-angle photos from low altitudes provided detailed analysis of command posts, dugouts, and machine gun / mortar positions. Discussions between aviation officers and infantry commanders proved valuable in validating air observations. The high command relied on this overview to support trench and maneuver warfare.[16]

BRITISH PR

British Royal Flying Corps reconnaissance provided timely, accurate, written reports of German force dispositions. The British field commander said these, “proved of great value” and helped “avert danger and disaster” in the Battle of Mons.[17] Commanders saw excellent French maps and were convinced of the full utility and advantage of aerial photography for tactical reconnaissance. By 1916, every front-line squadron had its own photographic section.[18]

AMERICAN PR

Four Balloon Squadrons were activated 1917 - 1918 when America entered World War I. Three served as observation units throughout France on the front lines. Early coalition cooperation included the 17th Pursuit Aero Squadron’s attachment to the RAF for operations and training in 1918.[19] Reconnaissance units took 18,000 photos in less than one year to support artillery units.[20]

INTERWAR YEARS

When	Where	Who	What	How
1934-1938	France	French Air Force	Repeat coverage of same target and use of multiple sources vital[21]	Reorganized
1938	America	Army Air Corps	Aerial Photography School, CO New cameras and film developed	Experimentation[22]
1939	Germany	PR units	Heavily photographed England	Reorganized[23]
1939	England	Sidney Cotton (Australian)	Flew first covert mission over Germany [24]	Lockheed -12 (American-made)
1939-1945	England	Constance Babington-Smith	Organized first Air section of CIU[25]	Reorganized/ Began training[26]
1940	France	Army and Air Force	Disintegrated from defensive doctrine and lack of spare parts [27]	France fell
1941	US/UK	Leaders	Collaboration in PI was key	
1941	England	American PIs	Trained at CIU	
1941	America	American PIs	Trained at Bolling Field	
1942	America	American PIs	Trained at Univ of MD and Harrisburg before going to UK	
1942	England	Eighth Air Force	Moved to UK	

TABLE 2 (TIMELINE OF STRATEGIC IMAGERY 1934-1945)

FRENCH PR

Pilots from the First World War were trained further at Orly Field Paris in 1922, and squadrons continued operational reconnaissance.[28]

GERMAN PR

In 1919, the Treaty of Versailles imposed a “complete ban on military aviation”. However, the Germans continued to develop air doctrine by the mid-1920s to include an air force whose mission included “close reconnaissance.”[29]

The chief military unit occupied with PR / PI work before 1935 was the *Hauptbildstelle der Reichswehr* (Main Photo Unit of the Reichwehr) staffed by civilians. Many interwar photographs of Europe were taken by sports flying clubs “who believed in the value of air photography for peace and war purposes.”[30] Aerial reconnaissance was highly valued by command staffs, and mentioned frequently for use during war gaming in 1937 summer exercises. From the end of 1938 until September 1939, France and southern England were heavily photographed. (See Figure 2). In 1939, the PR establishment reorganized but attempts were ineffective because no

one could convince Hermann Goering, the head of the Luftwaffe, of the importance of PR. He was uninterested in it.[31]

FIGURE 2 (GERMAN PRE-STRIKE PHOTO OF LONDON 1:100,000, 1938)[32]

BRITISH PR

Like her German and Allied counterparts, Britain's defense was gravely under-funded between 1918-1939.[33] Outdated bi-planes from the 1920's were still used for PR and the slow Blenheim was "suicidal" because it was slow and vulnerable. Sidney Cotton, an Australian pilot and early advocate for PR, insisted upon having Spitfires for PR, eventually receiving two.[34]

Flight Officer Constance Babington-Smith, an innovative and "most skilled" PI, described the early years of photo interpretation. Unfortunately, no specialized cadre of photo interpreters had been considered because the RAF apparently believed that any intelligence officer could be trained to do the job in a couple of weeks. In summer 1939, the Air Ministry had one experienced photo interpreter and the Army's photo reconnaissance section had only two.[35] Much of the tradecraft up to this time had been learned from the French.[36]

AMERICAN PR

Air intelligence reorganized and defined its role in the military. Camera technology evolved that provided coverage including one vertical and two oblique images. Infra-red and panchromatic film were invented. Cameras became bigger to operate from higher altitudes. A P-38 could photograph with a K-24 camera from 6,000 feet. These were often hand-held cameras with multiple lenses capturing up to fifty exposures. A nighttime flash was developed using an "Edgerton lamp that could deliver 200,000,000 candlepower intensity every three seconds."[37]

In 1938, the Army Air Corps incorporated photoreconnaissance into bombardment groups. Experimentation resulted in: "a wide-angle strip camera (excellent for terrain mapping); long-distance oblique cameras; high-altitude cameras plus a wide variety of film."[38]

DEVELOPMENTS IN THE SECOND WORLD WAR

Nothing in the intelligence arsenal was as effective as PR for determining enemy force deployment, target locations, bombing mission effectiveness, and essential mapmaking.[39] Senior leaders stated "without photo reconnaissance, the Army Air Force (AAF) would have lacked not only maps but a wide variety of methods to pinpoint specific targets."

PR missions were flown for various reasons: area coverage, point targets, enemy movements, damage assessment, and photographic support for land operations. Photo interpretation was an art that demanded great skill in assessing photographs, and an ability to reason and deduce facts from images. It depended on good weather and whether or not the pilot happened to turn on the camera if he saw something of interest!

There were three phases of photo interpretation. First-phase assessments were performed as quickly as imagery arrived from the aircraft. The intelligence staff demanded these assessments to determine the success of bombing raids. The timeline for report-writing in this phase decreased from two days to *two-three hours* in Britain. Second-phase included more details that could impact operations; analysis of this imagery continued for 24 hours. Third-

phase interpreters analyzed imagery in far more detail, to support long-term strategic and policy decisions. For example, aircraft factory changes rather than airfield activity were observed.[40]

FRENCH PR

The French Air Force was "hopelessly outclassed by the Luftwaffe" and the doctrine focused primarily on defensive operations, rendering the air force irrelevant.[41] By 1940, it could not protect and provide security for observer aircraft.[42] Aerial photography, a perilous endeavor, had been the sole source of monitoring German movements in collaboration with the British. After the German victory over the French, the French air bases were also available to the Luftwaffe for better access to the UK.

GERMAN PR

Between October 1939 and April 1940, naval bases, harbors and airfields in the United Kingdom were photographed, and the entire southern coast and the Thames Estuary were mapped.[43] In spite of the poor management of PR efforts establishment, the best efforts of the Luftwaffe were believed to have occurred between 10 July and 31 October 1940.[44] The most intense fighting of the Battle of Britain took place between 13 August and 15 September 1940 denying the Luftwaffe air superiority and their ability to photograph the pre invasion planning of Britain's southern coast.[45]

Many German PR professionals had been reconnaissance pilots during WORLD WAR I. They planned for an Air Inspectorate for Aerial Photography, staffed by civilians. This organization would have centralized military and civilian aerial photography within the same department. The entire field of photogrammetry suffered from a lack of supervision; most of the program was ignored. No one of high enough rank could sponsor air photography at higher headquarters."[46]

Nevertheless, London was photographed successfully by the Germans for the planning of V-weapons. Boxes containing hundreds of pre-strike photographs of British cities reside at the National Archives Records Administration (NARA) in College Park, Maryland.[47] These pre-D-day photos were important because they provided estimates of Allied intentions. Using these photos and other information, Germany's estimate of the invasion was between 4 - 11 June 1944.[48] The Luftwaffe employed photo-flash bombs at night for ports not photographed during daylight.

One advancement in Germany's program was 11.8" wide film, which enabled the Germans to record more of the earth's surface than Allied counterparts. (The British film was 7" wide or narrower, and the American aerial film was 9" wide or narrower.)[49]

In 1945, Allied analysts reached the following conclusions about the German photo reconnaissance effort: "What could have been the finest photo reconnaissance organization in the world was bedeviled by problems that never, fortunately, were allowed to blind the Allies…". When they examined captured German briefing sheets, Allied teams said "…underground buildings were missed and semi-sunken buildings were not described as such." German PIs did not make many analytical comments, and important observations were overlooked on imagery. While there was a photographic intelligence school in Hildesheim, the curriculum emphasized how to handle cameras and photography, but offered little on how to interpret the imagery. [50]

The quality of interpretation made the difference. Dr. Hans-Georg Carls of Germany said, "The Germans did all the war time mostly PHOTO READING."[51] This referenced the major difference between merely scanning the photos, the German approach, versus analyzing the significance of what was found on the photos, the Allied methodology. Interpretation was not a German hallmark.[52] Potential long-term strategic intelligence was virtually ignored. They generally photographed industrial targets before an attack, not imaging them again until they were being assessed for damage. This resulted in a lack of information regarding industrial targets and enemy strength in 1940. Some target folders only had pen and ink changes and slips of paper on photography taken before 1939.[53].

After the War, Americans searched for the German photo library. Eventually, many boxes of photos of excellent quality were found in a Bad Reichenhall barn. Alice Davey, who had worked in the Pentagon putting together interpretation manuals for the Allies, had the opportunity to interview the head of the German Interpretation School. She learned that a key downfall of the German PI program was that Germans believed "that because a camera is a machine, all you've got to do is improve mechanical quality..." One of Davey's colleagues summed it up when he said, "It seems that Hitler….never found out that what counts most in P.I. is the people who are in it. They made all the mistakes we might have made if it hadn't been for our team of individualists." The Germans never used stereo coverage because they were not trained to acquire or exploit it. Stereo coverage results in a three-dimensional appearance giving a sense of height to objects on the image. They used single prints exclusively. Multiple authors emphasize this lack of stereo coverage as another key downfall in their PR program. [54]

Themes	German Downfalls in PR program
Leadership	Inability to convince Goering of utility of PR
People	Low staffing, low expectations of PIs, no innovation[55]
Training	Interpretation and use of stereo not taught
Analysis	Lack of commentary on activity, details overlooked
Approach	Technology more important than people
Process	Dissemination poor between Army and Division commands[56]

TABLE 3 (CHALLENGES OF GERMAN PR PROGRAM)

BRITISH PR

The art of British photo interpretation became highly developed in WORLD WAR II. The RAF had gained practical experience in aerial photography operations, and they had excellent cameras and better reconnaissance aircraft than the enemy. According to Dr. Carls, "The Allies did mostly PHOTOINTERPRETATION. They in my eyes were much more successful with their method. Even, if the quality of the images (and Cameras) of the German side have been [sic] somewhat better."[57] This is a critical lesson learned by the Allies that forms a foundation for training in geospatial-intelligence analysis (formerly photo interpretation / imagery analysis) today. Detailed analysis of shapes, sizes, shadows and signatures (patterns associated with specific activity) made the difference in the Allies' interpretation techniques.[58]

The influence of France's PR program on the British is connected through Sidney Cotton.

> On the 1st of January 1940, Cotton had the good fortune to be introduced to Colonel Lespair, the Commandant of the French PI School at Tigeaux. On touring the School, Cotton was shown target dossiers and it was plain from the techniques and analytical methods being employed, as well as he study of annotated product, that the French were a long way ahead of the RAF in interpretation….Arrangements were made for suitable personnel to attend the French PI Course; one of them being Douglas Kendall who had earlier worked for Aerofilms South Africa Subsidiary. Kendall subsequently went on to be the Task Control Officer at Medmenham became one of the foremost PIs of the war.[59]

A pilot who flew photo reconnaissance missions in 1942 had a thirty percent chance of returning from a mission because of the success of the Germans defenses.[60] R. V. Jones said that an additional challenge faced by pilots was the difficulty snapping the shutter quickly enough to capture the object before passing it while possibly being fired upon by light anti-aircraft weapons.[61]

> The pilot had to…dive and fly past the object to be photographed; the object would disappear under his wing, he had to guess when it would reappear behind the wing and fire the shutter accordingly. Since all this had to take place while he was flying at fifty feet and three hundred miles an hour, with quite possibly a light anti-aircraft gun firing at him, it is not surprising that he found it difficult.[62]

The accomplished PIs at the Central Interpretation Unit (CIU) in Medmenham, strongly influenced the creation of a similar Army Air Force (AAF) effort in the British Isles. The tradecrafts of PR and PI became significant tools for air and ground intelligence. The CIU was renamed the Allied Central Interpretation Unit (ACIU) and included RAF, USAAF, British and Canadian armies, the Royal Navy, the US Navy and Marines, and the U.S. Army Corps of Engineers.[63] All PI information (including classified records) held by the RAF was made available to the United States Army Eighth Air Force; both nations cooperated very closely until the end of the war.[64] This predated current Combined Joint operations and should serve as a model for today's Coalition intelligence analysts.

Prime Minister Winston Churchill's daughter, Sarah Oliver, was a photo interpreter. Her father embraced the use of photo-reconnaissance, especially stereo coverage, prior to the start of her career. The Allies routinely used this technique.

Post-strike imagery of Allied and American bombing attacks was evaluated much like Battle Damage Assessment (BDA) is conducted today. The primary source of monitoring static targets (bridges, airfields) continued to be PR. Every important target within the German transportation system was imaged by hundreds of reconnaissance missions.[65]

Two challenges PIs faced after bombing raids were differentiating the most recent damage from previous coverage, and verifying pilots' reports. Aircrews became disoriented and confused by smoke screens, which caused them to incorrectly identify landmarks. At Wilhelmshaven in 1943, for example, 300 crews claimed to have attacked points on the ground successfully, but new damage was not ascertained by photo reconnaissance.[66]

Battle Damage Assessment (BDA) was often corroborated by using German reports of structural damage, resulting in more thorough interpretation. These Ultra reports referred to the classified reports with Enigma-derived intelligence that described the interception of German radio transmissions. Some felt these were more important than radar during the Battle of Britain.[67] Eventually, Ultra signals describing bomb damage were received the day after a bombing raid. PR was planned the next day which confirmed Enigma traffic. These two tools worked extremely well together.[68]

Prior to D-Day, the Allies photographed a 7500 square-mile area of France four times with more than one hundred selected locations weekly. Information derived from photo interpretation

"provided incontrovertible visual evidence" of enemy activity. The photographs effectively validated agent report reliability. In August 1943, *Operation Crossbow's* mission was to locate and destroy V1 and V2 rocket production. Babington-Smith first observed a "white mark, T-shaped, on a tiny ramp near bit earthworks and other mysterious installations at Peenemunde" where unmanned German rockets were researched and produced. This was the type of bomb that was launched into London. The RAF took over one million photographs during the V-weapon campaign.[69] Through close Allied cooperation between PR and Bomber Command, the facility was targeted, heavily bombed (killing 735 people including scientists), and research and production were delayed for six months.[70] (See Figure 3.)

PEENEMUNDE

BEFORE AFTER

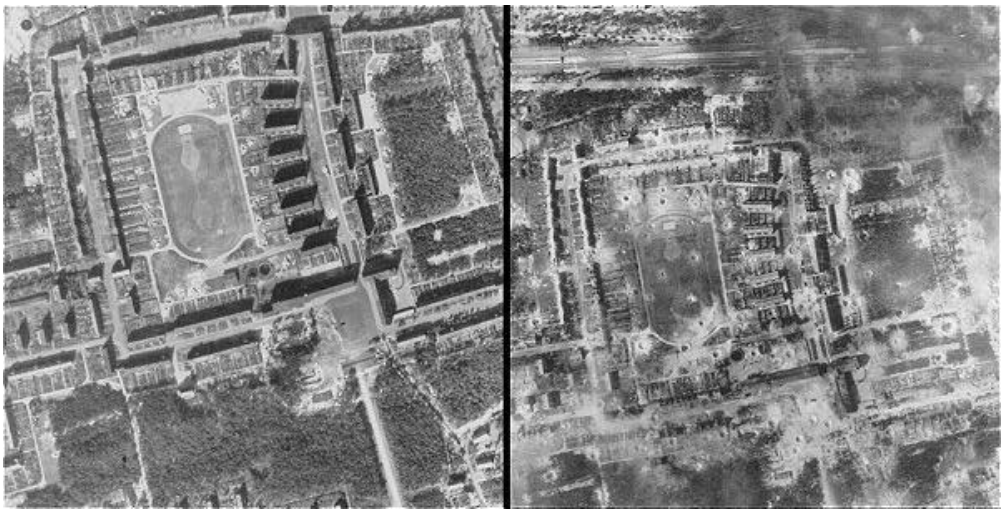

FIGURE 3 (PEENEMUNDE PRE-STRIKE AND POST-STRIKE AUGUST 1943)[71]

By 1944, PIs at CIU studied targets that could not be overlooked because every location could be a hiding place for weapons: lunatic asylums, chocolate factories, vast fantastic underground workshops, firebreaks in pine forests, and tunnels on autobahns."[72] The life of a PI was difficult, involving shift work, intense concentration and attention to detail. Mrs. Diane Cussons, a British PI at the CIU said there were no more than seven PIs on duty at any given time, and they worked twelve hours on and 24 hours off. She said the pilots brought back "the most massive amounts of … imagery by 2000 hours". New coverage had to be compared with the most recent coverage "with your mind working overtime". PIs tried to answer: "Are there

FIGURE 4 (ALLIED PI AT WORK IN UK 1943)[73]

more barges in Calais? Are there more aircraft at this aerodrome? What is that strange little thing at Peenemunde that wasn't there the last time we looked?" Written reports had to be completed and disseminated within 24 hours.[74] (See Figure 4.)

AMERICAN PR

The American officers in Great Britain realized how critical photo intelligence was to Allied bombing, both tactically and strategically, and were convinced that no modern air force could succeed without it. The Eighth Air Force desired its own independent ability to perform PR for this unique intelligence-gathering capability. [75] Maps and photographs of targets eliminated the need for some planned missions if BDA revealed total destruction of targets. Aerial photography also contributed to target prioritization and built the baseline for target folders. It enabled planners to know which targets needed to be revisited.[76]

As early as January 1941 senior British and American leaders agreed that collaboration was key. Americans trained at the British CIU in August 1941 and months later, the AAF 10-day photo intelligence program was started ironically on 8 December 1941 at Bolling Field in Washington, D.C. In February 1942, classes were held at the University of Maryland in College Park. Eventually, a facility was purchased in Harrisburg, PA. Analysts went to Britain to work in

the ACIU from there. As the Eighth Air Force moved into the UK, separate units consisting of B-24s and B-17s specializing in PR were introduced in the spring of 1942. Graduates from the Harrisburg school attended the RAF Intelligence School. Eventually, thirty AAF, thirty Army and eleven Navy personnel worked as interpreters at Medmenham.[77]

One American initiative was the development of Geerlings maps, named for Captain Harold Geerlings, in the absence of adequate map coverage by the British. (Since most of the British missions were flown at night, extremely detailed maps were not required.) These "perspective target maps" provided several approaches to the target, not a straight-down view. They facilitated more accurate bombing and situational awareness. The presence of artillery, searchlights, smoke screens, decoys and radars were also annotated on the Geerlings maps.[78]

World War Two PR Squadrons included Photographic, Observation, Photographic Charting, Reconnaissance, Strategic Reconnaissance, Photographic Reconnaissance, Tactical Reconnaissance and Surveillance.[79] This excerpt describes PI work in 1943 as part of the 95th Bombardment Group (USAAF) which flew B-17's out of Horham, England from 15 June 1942 - 28 August 1945.[80]

> In the Operations Building at nearby Horham, American Lt. David Henderson of the 95th's Photographic Section selected the relevant Target Folder marked "MUENSTER" from the filing cabinet.
>
> He sat down and quickly thumbed through the pages which described the target, its location, industries, defences, and its importance to the Third Reich. Also in the file, were the most up-to-date aerial photographs of Muenster…The photographs had been taken by the RAF's reconnaissance units with specially trained crews equipped with fast and high-flying Mosquitoes.[81]

POST WORLD WAR TWO PR DEVELOPMENTS IN THE UNITED STATES

There were many technological developments after World War Two (recce flights, U-2, unmanned aerial vehicles, airbreather platforms) many of which are highlighted below in Table 4.

When	Where	Platform	What
1948-1950	U.S.	B-47	Medium Bomber used for reconnaissance and photomapping
1949-1950	Siberia/ South China	U-2	Reconnaissance missions [82]
1950-1953	Korea	RB-45 Tornado[83]	Reconnaissance missions
1954	Soviet Union	RB-47	Reconnaissance in support of Strategic Air Command.[84]
1956	Soviet Union	U-2	Reconnaissance over denied territory
1960s	Vietnam	RPV/Firebees[85] RF-4C[86]	Remotely piloted vehicles flew combat reconnaissance
1960-1972	Global	Corona	First U.S. imaging satellite program[87]
1962	Cuba	U-2	Soviet Ballistic Missiles and light jet bombers revealed
1963-1997	Global	SR-71	Surveyed 100,000 sq miles of land per hour at 2,000 mph[88]
1964-2005	Global	UAV programs Hunter, Predator, Global Hawk[89]	UAVs in reconnaissance/intelligence-gathering roles since 1950's [90]
1990s	Iraq	Cockpit Video Cameras	Provided immediate feedback during Desert Storm bombing
1990s	Global	Commercial Satellites	Can augment national systems and provide unclassified products to coalition

TABLE 4 (TIMELINE OF STRATEGIC IMAGERY 1948-2005)

U-2 FLIGHTS

During the Cold War between the United States and the Soviets (mid to late twentieth century), concern over nuclear weapons was heightened. The first U.S. president to approve overflights of denied areas after World War II (1948-1950) was President Harry Truman. President Dwight Eisenhower appreciated photo reconnaissance from World War II authorizing U-2 flights. U-2 pilot Gary Powers was shot down over the Soviet Union in May 1960 and the National Photographic Interpretation Center (NPIC) in Washington D.C. was created in 1961.[91] It was staffed primarily by American service members who had worked in the CIU in the UK during World War II.

The best known strategic use of imagery intelligence in the western hemisphere occurred during the Cuban Missile Crisis of 1962, one hundred years after the use of military balloons in

the U.S. Civil War. U-2 flights revealed Medium-Range Ballistic Missile (MRBM) and Intermediate-Range Ballistic Missile (IRBM) activity, as well as the assembly of IL-28 Beagle light jet bombers at several airfields. (See Figure 5). The results of the photo interpretation affected national policy immediately. The Soviets were given an ultimatum to remove the missiles. U.S. planes and helicopters flew low reconnaissance missions to monitor the cargo on the decks while the missiles were being transported from Cuba by Soviet ships,[92]

The British were actively assisting the U.S. during this endeavor. The unique Anglo-American relationship facilitated the successful sharing of imagery intelligence twenty years after World War II. While the British Ministry of Defense (MOD) was supportive of the intelligence sharing, the British press was skeptical about the photos shown of Cuban missiles. Prime Minister Harold Macmillan ordered the best British photo interpreters at the Joint Air Reconnaissance Intelligence Centre (JARIC), RAF Brampton, to interpret the photos of the Cuban missile sites. “Their evaluations not only substantiated the American interpretation but also established that the U.S. interpretation effort was far more comprehensive than the British could have accomplished within the same time frame."[93]

CORONA

President Eisenhower also approved the first U.S. imaging satellite program, Corona, which operated from 1960 -1972. Technology and politics converged the summer of 1960 establishing a national intelligence capability in space, and an infrastructure to support it.

FIGURE 5 (U-2 IMAGERY OF CUBA 1962)[94]

NEAR REAL-TIME

Space reconnaissance provides unique advantages: 1) a wider range of civilian and national customers including the National Command Authority and the Intelligence Community (IC); 2) a reduced exploitation timeline; 3) a provision of up-to-date information about areas in which pilots will fly, saving lives; 4) monitoring of denied areas without alerting the enemy; 5) identification of more precise ground locations; 6) improvement of analysts' understanding of "normal" in any given area increases with frequent coverage [95]

Nearly thirty years after the Cuban Missile Crisis, NPIC imagery analysts noticed that Iraqi forces had unexpectedly deployed near the Kuwaiti border in mid-July 1990. Operation Desert Shield was launched when Iraq invaded Kuwait in August 1990. BDA was critical in the analysis of imagery once the air war ensued following the Iraqis' refusal to withdraw. This was the beginning of Desert Storm. Every target was studied in three phases and analytical reports went forward to the CENTCOM Theater as quickly as the bandwidth would allow. Pilots augmented BDA by provided timely feedback on the accuracy of their bombing efforts using cockpit videos from aircraft cameras that were oriented to their targets on the ground.

INTRODUCTION OF THE NIMA / NATIONAL GEOSPATIAL-INTELLIGENCE AGENCY (NGA) WORKFORCE

The IMINT tradecraft has transformed since the end of Desert Storm in 1991. There were several IMINT lessons learned from Desert Shield / Storm including the need for more analysts, bandwidth, timely reporting, and less stovepiping of information (reluctance to share with interagency counterparts.) These lessons influenced the creation of the National Imagery and Mapping Agency (NIMA) on 1 October, 1996. This Department of Defense (DoD) combat support agency resulted from the merger of NPIC and the Defense Mapping Agency (DMA) as well as multiple organizations from the IC. The purpose was to consolidate tasks and more centrally manage imagery intelligence and mapping functions, providing better customer service world-wide as new technologies became available. Commercial imaging systems were being developed, and digital processing was becoming the norm.[96]

Secretary of State Colin Powell used declassified IMINT products to brief the United Nations in February of 2003 prior to Operation Iraqi Freedom (OIF). Weeks later, on 17 March 2003, IMINT showed vehicle activity outside Iraqi bunkers 20 miles south of Baghdad. They appeared to be moving arms and equipment just before the U.S. invaded Iraq. An unconfirmed report stated a convoy appeared to be headed towards the Syrian border. A photo of the bunker activity was released 28 October 2004 by the DoD. (See Figure 6). As he introduced imagery examples into his briefing, Secretary Powell said:

> Let me say a word about satellite images before I show a couple. The photos that I am about to show you are sometimes hard for the average person to interpret, hard for me. The painstaking work of photo analysis takes years and years of experience, poring for hours and hours over light tables. But as I show you these images, I will try to capture and explain what they mean, what they indicate to our imagery specialists.[97]

Since NIMA's standup nearly ten years ago, the workforce has undergone an unprecedented transformation. NIMA's name was changed to the National Geospatial-Intelligence Agency (NGA) effective 24 November 2003. It continues to be an integral part in the Global War on Terrorism (GWOT) providing timely, relevant and accurate GEOINT products to customers worldwide in support of national security objectives.

At the end of 2004, the Director of NGA, Air Force Lt. Gen. (Ret.) James R. Clapper, Jr. said, "Our work force is now over 50 percent contractors...Now and in the future, we will look to the private sector to help provide us with the human talent, expertise and technology we need. We must move into the future together so we can better protect our citizenry."[98] It is imperative to remember, however, that "contracting out cannot provide future leadership".[99]

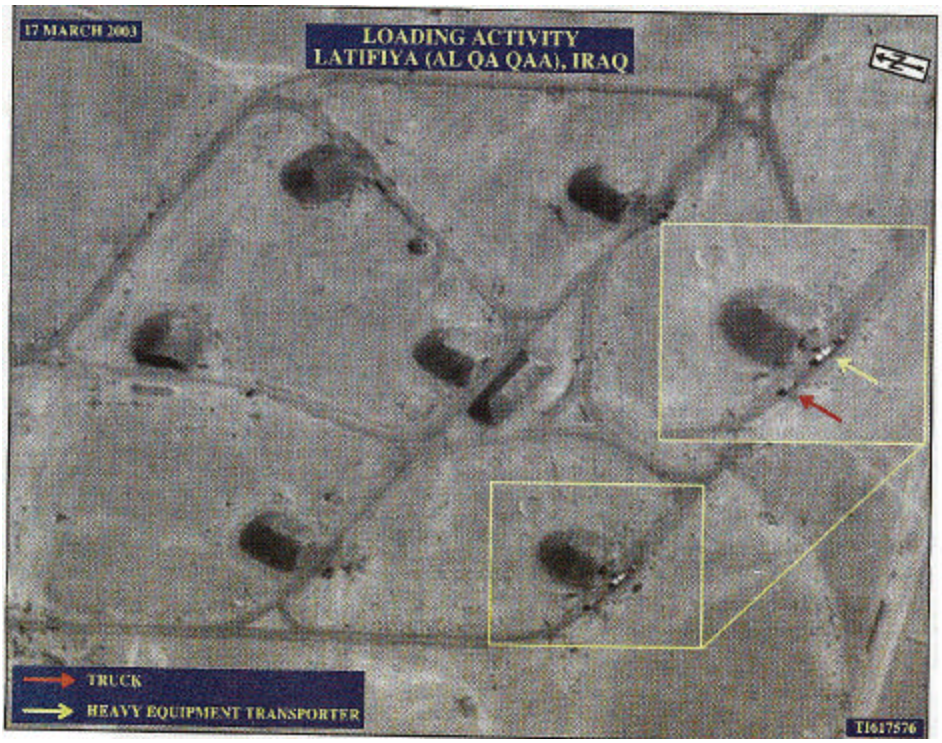

FIGURE 6 (DOD RECONAISSANCE PHOTO OF IRAQI STORAGE COMPLEX 2003) [100]

There used to be two primary occupations in NIMA: imagery analyst and cartographer. Today, with the onset of geospatial-intelligence (GEOINT), both of these arts (some say sciences) are merging closer together requiring a new generation of geospatial-intelligence analysts (GA). GEOINT is derived from imagery and geospatial information that is exploited and analyzed to place geography and terrain in context with specific points on the earth. Today's modern analysts accomplish the same tasks that their predecessors did 50-90 years ago: they perform BDA and verify pilots' reports, monitor enemy forces, and interpret and visually describe the terrain and geography.

Since 1998, approximately 580 cartographers have been trained in GEOINT with more cross-training available to imagery and geospatial-analysts in the Geospatial-Intelligence Training Program (GITP). The NGA College also offers a class in Analytical Thinking to all new employees. In a 2004 workforce survey, many analysts felt they had been provided sufficient opportunities to improve their skills and become eligible to advance in their job.[101] An integral part of this is NGA's Phoenix Program, a leadership development program built for each skill

level, not just managers. The goal is to grow leaders for the future and build a single leadership culture for the agency. The Director stated, "Investing in leadership development, in addition to technical skills development is key to NGA's future success."[102]

CONCLUSIONS

Over the past ninety years, several recurring themes were fundamental to the sustained success and development of strategic imagery intelligence techniques in support of national objectives from World War I to the present. The French, German, British and American programs were similar in mission and equipment. Some believe the Germans had superior photographic equipment over the Allies in both World Wars. Yet, partnership of the US / UK workforce made the difference in World War II, helping to securing the peace and creating a model for contemporary coalitions.

The GEOINT program in the United States continues to evolve and push the tradecraft to new heights. It has advanced from extraordinarily large computers and heavy light tables to computer workstations that have the ability to produce a GEOINT product in a matter of minutes instead of hours. Analysts can potentially spend more time analyzing GEOINT and updating databases than ever before. Our new workforce is still relatively young however, and requires careful mentoring and attention. The historical themes, lessons learned, and strengths of the profession, are summarized below

Themes	Impact on tradecraft
Purpose	Few changes over time – strategic mission unchanged, BDA, monitoring enemy movements, three phases of exploitation
Problem	Response to global challenges and interagency requests
Platform	PR progressed from open cockpit to cockpit videos / UAVs
People	Multi-generational workforce still bear traits of persistence, attention to detail, dedication, flexibility and inventiveness
Progress	Tradecraft technologically superior world-wide

TABLE 5 (THEMES OF STRATEGIC IMAGERY 1915-2005)

RECOMMENDATIONS

> The only irreplaceable capital an organization possesses is the knowledge and ability of its people. The productivity of the capital depends on how effectively people share their competence with those who can use it.
>
> - Andrew Carnegie[103]

My first recommendation addresses the management of NGA's workforce, its most valuable commodity. Contemporary management theories abound and the World War II Germans' PR program provided evidence of what can happen in peacetime and in war if the workforce is not carefully mentored, trained and retained.

With the stiff competition of contractors who attract potential employees exiting the armed services and colleges, NGA must focus on ways to understand, retain and multiply its workforce. Dr. Leonard Wong, U.S. Army War College Strategic Studies Institute, studied the differences in values between Generation X and Baby Boomers. The X generation is more balanced in their approach to work and personal time. They are not impressed by rank or position.[104] The Special Operations Forces Command advocates that "Humans are more important than hardware."[105] General Gordon Sullivan, USA (Ret) went a step further when he wrote "People and organizations are inseparable; you cannot value your organization without valuing the people in it...People who belong to an organization with a strong sense of purpose can identify with that purpose.[106] The future success of our nation's ability to preserve the peace depends heavily on our employees, both military and civilian.

NGA's current leadership is postured in the right direction and I recommend that all NGA managers adhere to the Director's guidance. In his "Ten Precepts for Leadership" Lt. Gen. (Ret) James Clapper said: "Put People First – if you don't take care of them, you will ultimately fail, even if all your systems are "green" (as in a green light or go ahead.)[107] Technology is important in this business, but as we learned from the Germans in World War II, quality, training and morale of analysts is far more important.

My second recommendation for improving the quality of the NGA workforce is to build permanent Coalition Imagery Teams. The professional example which was built between the British and Americans in World War II is unsurpassed. They pursued common goals. The synergy and success of these new teams would provide a baseline to further advance coalition cooperation. The mentoring that would occur between the senior and junior analysts would be invaluable. In October 2004, a ceremony took place at NGA's Washington Navy Yard facility, dedicating a room to Flight Officer Constance Babington-Smith, the British photo interpreter who first discovered the V rockets at Peenemunde on imagery. She was a pioneer of the coalition spirit at Medmenham.[108]

The Joint Forces Land Component Commander (JFLCC) Handbook considers Multi-National Operations in this way: "Each is unique…and varies with the international situation and perspectives, motives, and values of the organization's members."[109] The second and third order effects of building multinational imagery teams include breaking through the barriers of

classification issues that have plagued Allies since World War II, and the implementation of common classified computer systems with which imagery exploitation can occur. In Coalition Command and Control: Key Considerations , Martha Maurer states “The divisive forces within a coalition must be overcome by powerful motivation for the coalition to be successful...and the U.S. military must rely on its flexibility in doctrine and adaptability of procedures.”[110]

Strategic applications of GEOINT are still being invented in NGA. The partnership between Coalition and NGA analysts to fight future wars can be strengthened in what were once unimaginable ways. There’s no better time than the present to team NGA analysts ever closer with their multi-national counterparts to create force multipliers and unity of effort. The Global War on Terror will not end soon but by incorporating both a well-managed and multi-national workforce, NGA could assure a protracted success of retention, mentoring, and critical thinking in the tradecraft of GEOINT.

WORD COUNT= 5,534

ENDNOTES

[1]Martin Bowman, *Mosquito Photo-Reconnaissance Units of World War II* (Oxford, UK: Osprey Publishing, 1999), 6.

[2]F. Stansbury Haydon, *Military Ballooning during the Early Civil War* (Baltimore: The Johns Hopkins University Press, 1941), xxv, xxxvi.

[3]Chris Staerck, *Allied Photo Reconnaissance of World War Two* (San Diego: Thunder Bay Press, 1998), 6.

[4]Constance Babington-Smith, *Air Spy: The Story of Photo Intelligence in World War II* (New York: Harper & Brothers, 1957), 8.

[5]Ibid., 8.

[6]Haydon, 94.

[7]Staerck., 6.

[8]Babington-Smith., 6.

[9]Staerck.,7.

[10]Benjamin F. Crew, Jr., "A Short History of Aerial Reconnaissance and Imagery Analysis," briefing slides, Washington, National Geospatial-Intelligence Agency, 2004, slide 27. Cited with permission of Mr. Crew.

[11]Staerck, 7.

[12]Jeffrey Watson, *Sidney Cotton: The Last Plane out of Berlin* (Sydney, AUS: Hodder Headline Australia Party, 2002), 41.

[13]John F. Kreis, *Piercing the Fog: Intelligence and Army Air Forces Operations in World War II* (Washington: Bolling Air Force Base, 1996), 15.

[14]Crew, slide 22.

[15]Tami D. Biddle, *Rhetoric and Reality in Air Warfare: The Evolution of British and American Ideas About Strategic Bombing 1914-1945* (Princeton: Princeton University Press, 2002), 25.

[16]James S.Corum and Richard R.Muller, *The Luftwaffe's Way of War: German Air Force Doctrine 1911-1945* (Baltmore: The Nautical & Aviation Publishing Company of America, 1998), 37-39 5, 6, 61-63,88.

[17]Kreis, 15.

[18]Staerck, 8.

[19]Mauer Mauer, *Combat Squadrons of the Air Force : World War II* (Washington: Office of Air Force History, 1982), 11.

[20]Staerck, 10.

[21]Shawn J. Dilles <Shawn.J.Dilles@nga.mil>, "Comment on the Paper," electronic mail message to Cheryl McAuley <cheryl.duval.mcauley@us.army.mil>, 21 December 2004.

[22]Kreis, 5.

[23]Christopher R. Elliott, "Luftwaffe PR in World War II: Part I," *Air Pictorial* (November 1980): 437.

[24]Staerck,10.

[25]Kreis, 92.

[26]Babington-Smith, 13.

[27]Pierre Mariage, "L'aviation d'Observation les G.A.O.," *Icare Revue de L'aviation Francaise, 1939-40*, 4 (Automne-Hiver 1971): 115.

[28]Ibid., 115.

[29]Corum, 6.

[30]Elliott, 437.

[31]Ibid., 437.

[32]National Archives Records Administration (NARA) at College Park, MD, Photograph No. 429, DT/TM 3 Box 2; "London," 1938.

[33]Williamson Murray and Allan R. Millett, *Military Innovation in the Interwar Period* (Cambridge, UK: Cambridge University Press, 1996), 103.

[34]Watson, 131-135.

[35]Babington-Smith,13.

[36]Benjamin F. Crew <Benjamin.F.Crew@nga.mil>, "RE: RE: Hope this gets to you!" electronic mail message to Cheryl McAuley <cheryl.duval.mcauley@us.army.mil>. 15 February 2005.

[37]Staerck, 12.

[38]Kreis, 5.

[39]Roy M. Stanley, II, *World War II Photo Intelligence* (New York: Charles Scribner's Sons, 1981), inside front jacket.

[40]Kreis, 80.

[41]Meilinger, xviii.

[42]Mariage, 115.

[43]Staerck, 30.

[44]Elliott, 437.

[45]Staerck, 30.

[46]U.S. War Department, Military Intelligence Division, *German Military Intelligence, 1939-1945* (Frederick, MD: University Publications of America), 284.

[47]NARA.

[48]Christopher R. Elliott, "Luftwaffe PR in World War II: Part II," *Air Pictorial* (November 1980), 478.

[49]Roy M. Stanley, II, *To Fool a Glass Eye: Camouflage versus Photoreconnaissance in World War II* (Washington: Smithsonian Institution Press, 1998), 9.

[50]U.S. War Department, 286.

[51]Hans-Georg Carls <carls@luftbilddatenbank.de>, "Reconn," electronic mail message to Cheryl McAuley <cheryl.duval.mcauley@us.army.mil>, 29 August 2004.

[52]U.S. War Department, 287.

[53]Elliott, Part II, 480.

[54]Babington-Smith, 184-5, 112, 185.

[55]Elliott, Part I, 436.

[56]U.S. War Department, 286.

[57]Carls.

[58]Stanley, *To Fool a Glass Eye*,13.

[59] Joint Aerial Reconnaissance Intelligence Centre, *JARIC 1940-2000 60th Anniversary Book* (RAF Brampton, UK: JARIC, 2000), np.

[60]Watson, 144.

[61]R.V. Jones, *The Wizard War: British Scientific Intelligence 1939-1945* (New York: Coward, McCann & Geoghegan, 1978), 225.

[62]Ibid., 226.

[63]Ursula Powys-Lybbe, *The Eye of Intelligence* (London: William Kimber & Co., 1983), 9.

[64]Charles Webster and Noble Frankland, *The Strategic Air Offensive against Germany 1939-1945, Vol II: Endeavour Part 4*. (London: Her Majesty's Stationary Office, 1961), 222.

[65]Kreis, 226.

[66]Webster, 106.

[67]Williamson, 297.

[68]Kreis, 75.

[69]Kreis, 93.

[70]The Reader's Digest Association, *Secrets & Spies: Behind-the-Scenes Stories of World War II* (Pleasantville, NY: The Reader's Digest Association, 1964), 567, 568.

[71]Crew, slide 61.

[72]Kreis, 92.

[73]Crew, slide 54.

[74]H. Neubroch, *Proceedings 10* (Watford, UK: Royal Air Force Historical Society,1991), 57, 58.

[75]Kreis , 6.

[76]Ibid., 93-94.

[77]Ibid., 126-127.

[78]Ibid., 135.

[79]Mauer, 807.

[80]Ibid., 412.

[81]Ian Hawkins*, Munster: The Way it Was* (Anaheim, CA: Robinson Typographics, 1984), 61.

[82]R. Cargill Hall, *Early Cold War Overflights: Symposium Proceedings, Volume I: Memoirs* (Washington: National Reconnaissance Office, Office of the Historian, 2003), 334.

[83]United States Air Force Museum , "North America B-45C Tornado," available from <www.wpafb.af.mil/museum/modern_flight/mf10.htm>; Internet; accessed 23 January 2005.

[84]United States Air Force Museum , "RB-47E Overflies Russia 8 May 1954," available from <http://www.wpafb.af.mil/museum.htm>; Internet; accessed 23 January 2005.

[85]United States Air Force Museum , "Teledyne Ryan AQM-34L "Firebee," available from <www.wpafb.af.mil/museum/modern_flight/mf53.htm>; Internet; accessed 23 January 2005.

[86]United States Air Force Museum , "McDonnell-Douglas RF-4C Phantom II," available from <www.wpafb.af.mil/museum/ind/rind.htm>; Internet; accessed 23 January 2005.

[87]Walter T. Hitchcock, *The Intelligence Revolution: A Historical Perspective* (Washington, U.S. Air Force Academy,1991), 233.

[88]R.A Mason, *Air Power: An Overview of Roles* (London: Brassey's Defence Publishers, 1987), 80.

[89]Air Force Link, "Factsheet: RQ-/MQ-1 Predator Unmanned Aerial Vehicle," available from <www.af.mil/factsheets/>; Internet, accessed 25 January 2005.

[90]Federation of American Scientists, "Intelligence Resource Program , RB-47," available from <http://www.fas.org/irp/index.html>; Internet; accessed 23 January 2005.

[91]Hall, 336.

[92]Dino A. Brugioni, *Eyeball to Eyeball: The Inside Story of The Cuban Missile Crisis* (New York: Random House, 1990), photos 1-47.

[93]Brugioni, 380.

[94]Crew, slide 11.

[95]Hall, 368.

[96]Jeffrey T. Richelson, *The Wizards of Langley: Inside the CIA's Directorate of Science and Technology* (Boulder, CO: Westview Press, 2001), 273.

[97]Colin Powell, "Statement to the UN," 5 February 2003; available from <http://www.whitehouse.gov/infocus/iraq/index.html>; Internet; accessed 23 January 2005.

[98]James R. Clapper, Jr. "A Sense of Urgency," *Pathfinder* (November/December 2004): 4.

[99]Melinda McMillon Darby, "Civilian Soldiers Supporting the Global War on Terror," briefing slides, Carlisle, PA, Army War College, 9 February 2005, slide 8.

[100]Bill Gertz, "Pentagon: Photos Point to Removal of Weapons," *The Washington Times (*National Weekly Edition), 1-7 November, p.1.

[101]Dave Kendall<David G. Kendall@nga.mil>, "Re:Re Paper," electronic mail message to Cheryl McAuley <cheryl.duval.mcauley@us.army.mil>, 2 February 2005.

[102]National Geospatial-Intelligence Agency, "Leadership Training, Director's Message," available from <http://college.nga.ic.gov/htbin/td/dbman>, Internet; accessed 6 February 2005.

[103]U.S.Army War College,"Famous Quotes," available from<*http://cbnet.carlisle. army.mil/orgs/kmo/quotes.htm>;* Internet; accessed 27 November 2004.

[104]Leonard Wong, *Generations Apart: Xers and Boomers in the Officer Corps*,, (Carlisle, PA: U.S. Army War College, Strategic Studies Institute 2000), 6.

[105]*United States Special Operations Forces Posture Statement 2003-2004*; available from <http://www.socom.mil/Docs/2003_2004_SOF_Posture_Statement.pdf>; Internet; accessed 28 November 2004.

[106]Gordon R. Sullivan and Michael V. Harper, *Hope Is Not a Method* (New York: Broadway Books, 1996), 67, 68.

[107]James R. Clapper, "The Director's 10 Precepts for Leadership," *Pathfinder May/June 2003* (Bethesda, MD: National Imagery and Mapping Agency, 2003), 13.

[108]National Geospatial-Intelligence Agency, "Media Release: NGA-04-06," 13 October 2004; available from <www.nga.mil/NGASiteContent/StaticFiles/OCR/nga0406.pdf>; Internet; accessed 23 January 2005.

[109]Joint and Army Doctrine Directorate. *Joint Force Land Component Commander Handbook [JFLCC],* (Fort Monroe, VA: 2001), III-6.

[110]Martha E. Maurer, *Coalition Command and Control: Key Considerations* (Washington: National Defense University, 1994), 129.

GLOSSARY

AAF – Army Air Force

ACIU – Allied Central Interpretation Unit

BDA – Battle Damage Assessment

CIU – Central Interpretation Unit

DHS – Department of Homeland Security

DMA – Defense Mapping Agency

DOD – Department of Defense

DOE – Department of Energy

GA – Geospatial-Intelligence Analyst

GEOINT – Geospatial-Intelligence

GITP – Geospatial-Intelligence Training Program

GWOT – War on Terrorism

IA – Imagery Analyst

IC – Intelligence Community

IMINT – Imagery Intelligence

IRBM – Intermediate-Range Ballistic Missile

JARIC – Joint Aerial Reconnaissance Intelligence Centre

JFLCC – Joint Forces Land Component Commander

MOD – Ministry of Defence

MRBM – Medium-Range Ballistic Missile

NARA – National Archives Records Administration

NGA – National Geospatial-Intelligence Agency

NIMA – National Imagery and Mapping Agency

NPIC – National Photographic Intelligence Center

OEF – Operation Enduring Freedom

OIF – Operation Iraqi Freedom

PI – Photo Interpreter / Interpretation

PR – Photo reconnaissance

RAF – Royal Air Force

RPV – Remotely Piloted Vehicle

UAV – Unmanned Aerial Vehicles

BIBLIOGRAPHY

Aerial Picture School in Hildesheim. *Erkennung der Kraftwerke und Energieverteilungsanlagen im Luftbild*. Hildesheim, GE: Aerial Picture School, 1941.

Air Force Link. "Factsheet: RQ-/MQ-1 Predator Unmanned Aerial Vehicle." Available from <www.af.mil/factsheets/>. Internet. Accessed 25 January 2005.

Babington-Smith, Constance. *Air Spy: The Story of Photo Intelligence in World War II*. New York: Harper & Brothers, 1957.

Biddle, Tami D. *Rhetoric and Reality in Air Warfare: The Evolution of British and American Ideas About Strategic Bombing 1914-1945*. Princeton: Princeton University Press, 2002.

Blanchard, Ken, and Sheldon Bowles. *Gung Ho! Turn On the People in Any Organization.* New York: William Morrow and Company, 1998.

Bowman, Martin. *Mosquito Photo-Reconnaissance Units of World War II*. Oxford, UK: Osprey Publishing, 1999.

Brugioni, Dino A. *Eyeball to Eyeball: The Inside Story of The Cuban Missile Crisis*. New York: Random House, 1990.

Cantrell, Mark. "The Pilot Who Wasn't There." *Military Officer* (January 2005).

Carls, Hans-Georg <carls@luftbilddatenbank.de>. "Reconn." Electronic mail message to Cheryl McAuley <cheryl.duval.mcauley@us.army.mil>. 29 August 2004.

Clapper, James R, Jr. *"*The Director's 10 Precepts for Leadership*"*. *Pathfinder, 1 May/June 2003*.

--------. "A Sense of Urgency," *Pathfinder November/December 2004*.

Corum, James S. and Richard R. Muller. *The Luftwaffe's Way of War: German Air Force Doctrine 1911-1945*. Baltimore: The Nautical & Aviation Publishing Company of America, 1998.

Cox, Sebastian. "The Sources and Organisation of RAF Intelligence and Its Influence on Operations." in Hoorst Boog, ed. *The Conduct of the Air War in the Second World War: An International Comparison.* NY: St. Martin's Press, 1992.

Crew, Benjamin F., Jr. "A Short History of Aerial Reconnaissance and Imagery Analysis." Briefing slides. Washington: National Geospatial-Intelligence Agency, 2004. Cited with permission from Mr. Crew.

--------. <Benjamin.F.Crew@nga.mil>. "Briefing Slides et al." Electronic mail message to Cheryl McAuley <cheryl.duval.mcauley@us.army.mil>. 24 January 2005.

--------. <Benjamin.F.Crew@nga.mil>. "RE: RE: Hope this gets to you!." Electronic mail message to Cheryl McAuley <cheryl.duval.mcauley@us.army.mil>. 15 February 2005.

Darby, Melinda M. "Civilian Soldiers Supporting the Global War on Terror" Briefing slides. Carlisle, PA: U. S. Army War College, 9 February 2005.

Dilles, Shawn J. Shawn.J.Dilles@nga.mil. "Comments on the Paper." Electronic mail message to Cheryl McAuley <cheryl.duval.mcauley@us.army.mil>. 21 December 2004.

Deichmann, D. Paul. *German Air Force Operations in Support of the Army*. New York: Arno Press, 1968.

Doughty, Robert A. *The Seeds of Disaster: The Development of French Army Doctrine 1919-1939*. Hamden, CT: Archon Books, 1985.

Elliott, Christopher R. "Luftwaffe PR in World War II." Parts 1 and 2. *Air Pictorial* (December 1980): 436-440, 478-481.

Federation of American Scientists. "Intelligence Resource Program , RB-47." Available from <http://www.fas.org/irp/index.html>. Internet. Accessed 23 January 2005.

Gertz, Bill. "Pentagon: Photos Point to Removal of Weapons." *The Washington Times* (National Weekly Edition), 1-7 November 2004, p.1.

Going, Chris. *Evidence in Camera 1939-1944, Special Edition on Photographic Reconnaissance and Photographic Intelligence.* Cambridge, UK: The GeoInformation Group, 1945.

Greer, Thomas H. *The Development of Air Doctrine in the Army Air Arm 1917-1941* . Montgomery, AL: Maxwell Air Force Base, 1955.

Hall, R. Cargill, and Laurie D. Clayton. *Early Coldwar Overflights 1950-1956, Symposium Proceedings.* Washington: U.S. Government Printing Office, 2003.

Hawkins, Ian. *Muenster: The Way it Was*. Anaheim, CA: Robinson Typographics, 1984.

Haydon, F. Stansbury. *Military Ballooning during the Early Civil War*. Baltimore: The Johns Hopkins University Press, 1941.

Higham, Robin. *Air Power: A Concise History*. New York: St. Martin's Press, 1972.

Hitchcock, Walter T. *The Intelligence Revolution: A Historical Perspective*. Washington: U. S. Air Force Academy, 1991.

Hughes, Chris Chris Hughes@btinternet.com. "Re: Historical Information." Electronic mail message to Cheryl McAuley <Cheryl.McAuley@carlisle.army.mil>. 28 February 2005.

Independent Commission on the National Imagery and Mapping Agency. *The Information Edge: Imagery Intelligence and Geospatial Information in an Evolving National Security Environment.* Washington: The Commission, 2000.

Joint Aerial Reconnaissance Intelligence Centre. *JARIC 1940-2000 60th Anniversary Book* RAF Brampton, UK: JARIC, 2000.

Joint and Army Doctrine Directorate. *Joint Force Land Component Commander Handbook (JFLCC)*. Fort Monroe, VA: 2001.

Jones, R. V. *The Wizard War: British Scientific Intelligence 1939-1945*. New York: Coward, McCann & Geoghegan, 1978.

Kendall, David <David G. Kendall@nga.mil>. "Re:Re Paper." Electronic mail message to Cheryl McAuley <cheryl.duval.mcauley@us.army.mil>. 2 February 2005.

Kernaghan, Gary <pipergary17@hotmail.com>. "RE: My paper." Electronic mail message to Cheryl McAuley <Cheryl.McAuley@carlisle.army.mil>. 28 February 2005.

Kiesling, Eugenia C. *Arming against Hitler: France and the Limits of Military Planning*. Lawrence, KS: University Press of Kansas, 1996.

Kreis, John F. *Air Warfare and Air Base Air Defense, 1914-1973*. Washington: U.S. Air Force, Office of Air Force History, 1988.

--------. *Piercing the Fog: Intelligence and Army Air Forces Operations in World War II*. Washington: Bolling Air Force Base, Air Force History and Museums Program, 1996.

Lewin, Ronald. *Ultra Goes to War: The First Account of World War II's Greatest Secret Based on Official Documents.* New York: McGraw-Hill, 1978.

Mariage, Pierre. "L'aviation d'Observation les G.A.O." *Icare Revue de L'aviation Francaise: 1939-40* (Automne-Hiver 1971): 115-150.

Mason, R.A. *Air Power: An Overview of Roles*. London: Brassey's Defence, 1987.

Mauer, Martha E. *Coalition Command and Control: Key Considerations*. Washington: National Defense University, 1996.

Mauer, Mauer. *Combat Squadrons of the Air Force: World War II*. Washington: Office of Air Force History, 1982.

McDonald, Robert A. *A Selective Bibliography On Imagery Reconnaissance and Related Matters*. Washington: Defense Intelligence College, 1993.

Meilinger, Phillip S. *The Paths of Heaven: The Evolution of Airpower Theory.* Maxwell Air Force Base, AL: Air University Press, 1997.

Murray, Williamson, and Allan R. Millett. *Military Innovation in the Interwar Period*. Cambridge, UK: Cambridge University Press, 1996.

National Geospatial-Intelligence Agency. *Geospatial Intelligence (GEOINT) Basic Doctrine*. GEOINT Publication 1 Bethesda, MD: 2004.

National Geospatial-Intelligence Agency. "Leadership Training." Available from <http://college.nga.ic.gov/htbin/td/dbman>. Internet. Accessed 6 February 2005.

National Geospatial-Intelligence Agency. "Media Release: NGA-04-06." 13 October 2004. Available from <www.nga.mil/NGASiteContent/StaticFiles/OCR/nga0406.pdf>. Internet. Accessed 23 January 2005.

Nesbit, Roy Conyers. *Eyes of the RAF: A History of Photo-Reconnaissance*. Gloucestershire, UK: Alan Sutton Publishing, 1996.

Neubroch, H. *Proceedings 10*. Watford, UK: Royal Air Force Historical Society, 1991.

Noyes, Louise. "Air Spy: The Story of Photo Intelligence in World War II" and "The Eye of Intelligence." Book Reviews *Geospatial Intelligence Review* 2 (May 2004).

National Archives Records Administration (NARA). Photograph No. 429, DT/TM 3 Box 2 "London." 1938 NARA College Park, MD. Accessed 16 July 2004.

Powell, Colin. "Statement to the UN." 5 February 2003. Available from <http://www.whitehouse.gov/infocus/iraq/index.html>. Internet. Accessed 23 January 2005.

Powys-Lybbe, Ursula. *The Eye of Intelligence*. London, UK: William Kimber & Company, 1983.

Richelson, Jeffrey T. *The Wizards of Langley: Inside the CIA's Directorate of Science and Technology*. Boulder, CO: Westview Press, 2001.

Staerck, Chris. *Allied Photo Reconnaissance of World War II*. San Diego: Thunder Bay Press, 1998.

Stanaway, John, and Bob Rocker. *The Eight Ballers: Eyes of the Fifth Air Force*. Atglen, PA: Schiffer Publishing, 1999.

Stanley, Roy M., II. *To Fool A Glass Eye: Camouflage versus Photoreconnaissance in World War II*. Washington: Smithsonian Institution Press, 1998.

--------. *World War II Photo Intelligence: The First Complete History of the Aerial Photoreconnaissance and Photo Interpretation Operations of the Allied and Axis Nations*. New York: Charles Scribner's Sons, 1981.

Sullivan, Gordon R., and Michael V. Harper. *Hope Is Not a Method: What Business Leaders Can Learn from America's Army.* New York: Broadway Books, 1996.

The Reader's Digest Association. *Secrets & Spies: Behind-the-Scenes Stories of World War II*. Pleasantville, NY: The Reader's Digest Association, 1964.

U.S. Army War College. "Famous quotes." Available from <http://cbnet.carlisle.army.mil/orgs/kmo/quotes.htm>. Internet. Accessed 27 November 2004.

U.S. War Department. Military Intelligence Division. *German Military Intelligence, 1939-1945.* Frederick, MD: University Publications of America.

United States Air Force Museum. "McDonnell-Douglas RF-4C Phantom II." Available from <http://www.wpafb.af.mil/museum/ind/rind.htm>. Internet. Accessed 23 January 2005.

United States Air Force Museum. "North America B-45C Tornado." Available from <http://www.wpafb.af.mil/museum/modern_flight/mf10.htm>. Internet. Accessed 23 January 2005.

United States Air Force Museum. "RB-47E Overflies Russia 8 May 1954." Available from <http://www.wpafb.af.mil/museum/history/coldwar/cw13.htm>. Internet. Accessed 23 January 2005.

United States Air Force Museum. "Teledyne Ryan AQM-34L Firebee." Available from <http://www.wpafb.af.mil/museum/modern_flight/mf53.htm>. Internet. Accessed 23 January 2005.

United States Special Operations Forces Posture Statement 2003-2004. Available from <http://www.socom.mil/Docs/2003_2004_SOF_Posture_Statement.pdf>. Internet. Accessed 28 November 2004.

Watson, Jeffrey. *Sidney Cotton: The Last Plane Out of Berlin*. Sydney, AUS: Hodder Headline Australia Party, 2002.

Webster, Charles, and Noble Frankland. *The Strategic Air Offensive Against Germany 1939-1945 Volume II: Endeavour Part 4*. London: Her Majesty's Stationery Office, 1961.

Wong, Leonard. *Generations Apart: Xers and Boomers in the Officer Corps*. Carlisle, PA: U.S. Army War College, 2000.